WE CLAIM:

1. A machine-readable medium for programming a computer to determine positional error and remaining feature related tolerance for a plurality of manufactured internal features on an object, said medium including processor executable instructions comprising:

determining a true position for each of said plurality of manufactured internal features;

determining a framework from said true positions;

determining a location for each of said plurality of manufactured internal features;

determining a size of each of said plurality of manufactured internal features;

fitting said framework to said locations of each of said plurality of manufactured internal features to determine a fit framework;

determining the transformed relationship between the framework and the fit framework;

determining a relation for each of said plurality of manufactured internal features to said fit framework;

organizing each of said relations into a single association;

organizing the location of each of said plurality of manufactured internal features relative to said single association;

determining said positional error for each of said manufactured internal features from said single association;

determining a common region contained within said organized plurality of manufactured internal features;

determining a maximum inscribed circle within said region;

determining the diameter of said maximum inscribed circle;

determining the center location of said maximum inscribed circle;

determining the transformation of the center location of said

maximum inscribed circle from said single association; and

determining said remaining feature related tolerance from said maximum inscribed circle.

2. The machine-readable medium of Claim 1 where said manufactured internal features comprise a hole.

3. The machine-readable medium of Claim 1 where said processor executable instruction of determining a framework from said true positions comprises

determining positional tolerances of said features;

determining size tolerances of said features; and

selecting an origin.

4. The machine-readable medium of Claim 1 where said processor executable instruction of fitting said framework to said locations of each of said plurality of manufactured internal features to determine a fit framework comprises:

determining a center for each of a plurality of manufactured holes; and

best fitting true positions of said manufactured holes to said centers of said manufactured hole.

5. The machine-readable medium of Claim 1 where said processor executable instruction of determining the transformed relationship between the framework and the fit framework comprises:

determining a translation of the fit framework relative to the framework; and

determining a rotation of the fit framework relative to the framework.

6. The machine-readable medium of Claim 1 where said processor executable instruction of determining a relation for each of said plurality of manufactured internal features to said fit framework comprises

determining a center for a plurality of manufactured holes;

determining transformed true positions for each of said manufactured holes; and

determining locations of said centers of said manufactured holes from said transformed true positions.

7. The machine-readable medium of Claim 1 where said processor executable instruction of organizing each of said relations into a single association comprises

superimposing transformed true positions.

8. The machine-readable medium of Claim 1 where said processor executable instruction of organizing the location of each of said plurality of manufactured internal features relative to said single association comprises organizing the location of manufactured holes relative to a one true position.

9. The machine-readable medium of Claim 1 where said plurality of manufactured internal features is simulated manufactured internal features.

10. A machine-readable medium for programming a computer to determine positional error and remaining hole related tolerance for a plurality of manufactured holes on an object, said medium including processor executable instructions comprising:

determining a true position for each of said plurality of manufactured holes;

determining a feature related tolerance zone framework (FRTZF) from said true positions;

determining a center for each of said plurality of manufactured holes;

determining a size of each of said plurality of manufactured holes;

fitting said FRTZF to said centers of said plurality of manufactured holes to determine a best fit framework;

determining a transformed true position for each of said plurality of manufactured holes;

superimposing each of said transformed true positions to form a one true position;

determining the location of each of said plurality of manufactured holes relative to said one true position;

determining a common region contained within said manufactured holes represented about said one true position;

determining a first maximum inscribed circle within said common region;

determining the diameter of said first maximum inscribed circle;

determining a center location of said first maximum inscribed circle; and

determining said remaining hole related tolerance from said maximum inscribed circle.

11. The machine-readable medium of Claim 10 where said processor executable instruction of determining a feature related tolerance zone framework (FRTZF) from said true positions comprises

providing allowable size tolerances; and

providing positional tolerances.

12. The machine-readable medium of Claim 10 where said plurality of manufactured internal features is simulated manufactured internal features.

13. The machine-readable medium of Claim 10 where said processor executable instruction of determining a center for each of said plurality of manufactured holes comprises

acquiring the dimensions of said manufactured holes with a measuring device;

determining a second maximum inscribed circle for each of said manufactured holes; and

determining a center for each of said second maximum inscribed circles.

14. The machine-readable medium of Claim 10 where said processor executable instruction of determining a size of each of said plurality of manufactured holes comprises analyzing said plurality of manufactured holes with a measuring device.

15. The machine-readable medium of Claim 10 where said processor executable instruction of determining a common region contained within said manufactured holes represented about said one true position comprises

acquiring dimensions of each of said manufactured holes; and

determining a common area within each of said manufactured holes.

16. The machine-readable medium of Claim 15 where said processor executable instruction of determining said remaining hole related tolerance from said maximum inscribed circle comprises

providing a virtual condition for said manufactured holes; and

determining the difference between the diameter of the first maximum inscribed circle and said virtual condition.

17. The machine-readable medium of Claim 10 where said processor executable instruction of determining a common region contained within said manufactured holes represented about said one true position comprises

acquiring dimensions of each of said manufactured holes;

determining a second maximum inscribed circle for each of said manufactured holes; and

determining a common area within each of said second maximum inscribed circles.

18. The machine-readable medium of Claim 17 where said processor executable instruction of determining said remaining hole related tolerance from said maximum inscribed circle comprises

providing a virtual condition for said manufactured holes; and

determining the difference between the diameter of the first maximum inscribed circle and the virtual condition.

19. A machine-readable medium for programming a computer to evaluate compliance of a single internal feature in a pattern on an object, to the virtual condition, said medium including processor executable instructions comprising:

providing a pattern of features;

acquiring dimensions and location of a manufactured internal feature;

determining a maximum inscribed circle for said manufactured internal feature;

providing a virtual condition; and

determining if there is clearance between said maximum inscribed circle and the virtual condition.

20. The machine-readable medium of Claim 19 where said processor executable instruction of providing a pattern of features comprises providing a pattern of holes.

21. The machine-readable medium of Claim 19 where said processor executable instruction of acquiring dimensions and location of a manufactured internal feature comprises examining said object with a measurement device.

22. The machine-readable medium of Claim 19 where said processor executable instruction of determining if there is interference between said maximum inscribed circle and the virtual condition comprises

determining said maximum inscribed circle has a smaller size than said virtual condition; and

determining the difference between the diameter of the maximum inscribed circle and diameter of the virtual condition.

23. The machine-readable medium of Claim 19 where said processor executable instruction of determining if there is interference between said maximum inscribed circle and the virtual condition comprises

determining that said maximum inscribed circle has a smaller size than said virtual condition;

determining a center of the manufactured internal feature;

determining a center of the maximum inscribed circle; and

determining the location of the manufactured internal feature relative to the virtual condition.

24. The machine-readable medium of Claim 19 where said processor executable instruction of determining if there is clearance between said maximum inscribed circle and the virtual condition comprises

determining that said maximum inscribed circle has a larger size than said virtual condition;

determining a diameter of said maximum inscribed circle; and

determining a remaining allowable positional tolerance.

25. The machine-readable medium of Claim 19 where said processor executable instruction of determining if there is interference between said maximum inscribed circle and the virtual condition comprises

determining a best fit framework;

determining a one true position for the plurality of features containing said manufactured internal feature;

determining a center of the maximum inscribed circle; and

determining a location of said center relative to said true position.

26. The machine-readable medium of Claim 19 where said internal feature is a simulated manufactured internal feature.

27. A machine-readable medium for programming a computer to determine positional error for a plurality of manufactured holes on an object, said medium including processor executable instructions comprising:

determining a true position for each of said plurality of manufactured holes;

determining a framework from said true positions;

determining a center for each of said plurality of manufactured holes;

fitting said framework to said centers of said plurality of manufactured holes to determine a best fit framework;

determining a transformed true position for each of said plurality of manufactured holes;

determining a one true position from said transformed true positions;

determining the location of each of said plurality of manufactured holes relative to said one true position;

determining a common region contained within said manufactured holes represented about said one true position;

determining a first maximum inscribed circle within said common region;

determining the center of said first maximum inscribed circle; and

determining the location of said center of said first maximum inscribed circle relative to said one true position.

28. The machine-readable medium of Claim 27 where said processor executable instruction of determining a framework from said true positions comprises

providing allowable size tolerances;

providing positional tolerances; and

determining a feature related tolerance zone framework (FRTZF).

29. The machine-readable medium of Claim 27 where said processor executable instruction of determining a center for each of said plurality of manufactured holes comprises

acquiring the dimensions of said manufactured holes with a measuring device; and

determining the center of said manufactured holes from said dimensions.

30. The machine-readable medium of Claim 27 where said processor executable instruction of determining a center for each of said plurality of manufactured holes comprises

acquiring the dimensions of said manufactured holes with a coordinate measuring machine;

determining a second maximum inscribed circle for each of said manufactured holes; and

determining a center for each of said second maximum inscribed circles.

31. The machine-readable medium of Claim 27 where said processor executable instruction of determining the size of each of said plurality of manufactured holes comprises analyzing said plurality of manufactured holes with a coordinate measuring machine.

32. The machine-readable medium of Claim 27 where said processor executable instruction of determining a common region contained within said manufactured holes represented about said one true position comprises

acquiring dimensions of each of said manufactured holes; and

determining a common area within each of said manufactured holes.

33. The machine-readable medium of Claim 27 where said processor executable instruction of determining a common region contained within said manufactured holes represented about said one true position comprises

acquiring dimensions of each of said manufactured holes;

determining a second maximum inscribed circle for each of said manufactured holes; and

determining a common area within each of said second maximum inscribed circles.

34. The machine-readable medium of Claim 27 where said plurality of manufactured holes is simulated manufactured holes.

35. A method for determining positional error and remaining feature related tolerance for a plurality of manufactured internal features on an object, comprising:

determining a true position for each of said plurality of manufactured internal features;

determining a framework from said true positions;

determining a location for each of said plurality of manufactured internal features;

determining a size of each of said plurality of manufactured internal features;

fitting said framework to said locations of each of said plurality of manufactured internal features to determine a fit framework;

determining a relation for each of said plurality of manufactured internal features to said fit framework;

organizing each of said relations into a single association;

organizing the location of each of said plurality of manufactured internal features relative to said single association;

determining said positional error for each of said manufactured internal features from said single association;

determining a common region contained within said organized plurality of manufactured internal features;

determining a maximum inscribed circle within said region;

determining the diameter of said maximum inscribed circle; and

determining said remaining feature related tolerance from said maximum inscribed circle.

36. The method of Claim 35 where said manufactured internal features comprise holes.

37. The method of Claim 35 where said step of determining a framework from said true positions comprises

determining positional tolerances of said features;

determining size tolerances of said features; and

selecting an origin.

38. The method of Claim 35 where said step of fitting said framework to said locations of each of said plurality of manufactured internal features to determine a fit framework comprises:

determining a center for each of a plurality of manufactured holes; and

best fitting said true positions of a tolerance zone framework of said manufactured holes to said centers of said manufactured hole.

39. The method of Claim 35 where said step of determining a relation for each of said plurality of manufactured internal features to said fit framework comprises

determining a center for a plurality of manufactured holes;

determining transformed true positions for each of said manufactured holes; and

determining locations of said centers of said manufactured holes from said transformed true positions.

40. The method of Claim 35 where said step of organizing each of said relations into a single association comprises

superimposing transformed true positions.

41. The method of Claim 35 where said step of organizing the location of each of said plurality of manufactured internal features relative to said single association comprises organizing the location of manufactured holes relative to a one true position.

42. The method of Claim 35 where said plurality of manufactured internal features is simulated manufactured internal features.

43. A machine-readable medium for programming a computer to determine positional error and remaining feature relating tolerance for a plurality of manufactured external features, said medium including processor executable instructions comprising:

determining a true position for each of said plurality of manufactured external features;

determining a feature relating tolerance zone framework (FRTZF) from said true positions;

determining a center for each of said plurality of manufactured external features;

determining a size of each of said plurality of manufactured external features;

fitting said FRTZF to said centers of said plurality of manufactured

external features to determine a best fit framework;

determining a transformed true position for each of said plurality of manufactured external features;

superimposing each of said transformed true positions to form a one true position;

determining the location of each of said plurality of manufactured external features relative to said one true position;

determining a region encompassing said manufactured external features represented about said one true position;

determining a first minimum circumscribing circle about said region;

determining the diameter of said first minimum circumscribing circle; and

determining said remaining feature related tolerance from said minimum circumscribing circle.

44. The machine-readable medium of Claim 43 where said processor executable instruction of determining a feature relating tolerance zone framework (FRTZF) from said true positions comprises

providing allowable size tolerances; and

providing positional tolerances.

45. The machine-readable medium of Claim 43 where said processor executable instruction of determining a center for each of said plurality of manufactured external features comprises

acquiring the dimensions of said manufactured external features with a coordinate measuring machine;

determining a second minimum circumscribing circle for each of said manufactured external features; and

determining a center for each of said second minimum

circumscribing circles.

46. The machine-readable medium of Claim 43 where said processor executable instruction of determining a size of each of said plurality of manufactured external features comprises analyzing said plurality of manufactured external features with a measuring device.

47. The machine-readable medium of Claim 43 where said processor executable instruction of determining a region encompassing said manufactured external features represented about said one true position comprises

acquiring dimensions of each of said manufactured external features; and

determining an area encompassing each of said manufactured external features.

48. The machine-readable medium of Claim 47 where said processor executable instruction of determining said remaining feature relating tolerance from said minimum circumscribing circle comprises

providing a virtual condition for said manufactured external features; and

determining the difference between the diameter of the first minimum circumscribing circle and said virtual condition.

49. The machine-readable medium of Claim 43 where said processor executable instruction of determining a region encompassing said manufactured external features represented about said one true position comprises

acquiring dimensions of each of said manufactured external features;

determining a second minimum circumscribing circle for each of said manufactured external features; and

determining an area encompassing each of said second minimum circumscribing circles.

50. The machine-readable medium of Claim 49 where said processor executable instruction of determining said remaining hole relating tolerance from said minimum circumscribing circle comprises

providing a virtual condition for said manufactured external features; and

determining the difference between the diameter of the first minimum circumscribing circle and the virtual condition.

51. The machine-readable medium of Claim 43 where said plurality of manufactured external features is simulated manufactured external features.

52. A machine-readable medium for programming a computer to evaluate compliance of a single external feature in a pattern on an object, to the virtual condition, said medium including processor executable instructions comprising:

providing a pattern of external features;

acquiring dimensions and location of a manufactured external feature;

determining a minimum circumscribing circle for said single external feature;

providing a virtual condition;

and

determining if there is interference between said minimum circumscribing circle and the virtual condition.

53. The machine-readable medium of Claim 52 where said processor executable instruction of providing a pattern of external features comprises

providing a pattern of pins.

54. The machine-readable medium of Claim 52 where said processor executable instruction of acquiring dimensions and location of a manufactured external feature comprises examining said object with a measuring device.

55. The machine-readable medium of Claim 52 where said processor executable instruction of determining if there is interference between said second minimum circumscribing circle and the virtual condition comprises

determining said minimum circumscribing circle has a larger size than said virtual condition; and

determining the difference between the diameter of the minimum circumscribing circle and diameter of the virtual condition.

56. The machine-readable medium of Claim 52 where said processor executable instruction of determining if there is interference between said second minimum circumscribing circle and the virtual condition comprises

determining that said minimum circumscribing circle has a smaller size than said virtual condition;

determining a center of the manufactured external feature;

determining a center of the minimum circumscribing circle; and

determining the location of the manufactured external feature relative to the minimum circumscribing circle.

57. The machine-readable medium of Claim 52 where said processor executable instruction of determining if there is interference between said minimum circumscribing circle and the virtual condition comprises

determining that said minimum circumscribing circle has a smaller size than said virtual condition;

determining a diameter of said minimum circumscribing circle; and

determining a remaining positional tolerance.

58. The machine-readable medium of Claim 52 where said processor executable instruction of determining if there is interference between said minimum circumscribing circle and the virtual condition comprises

determining a true position of said manufactured external feature;

determining a center of the minimum circumscribing circle;

determining a location of said center relative to said true position.

59. The machine-readable medium of Claim 52 where said plurality of manufactured external features is simulated manufactured external features.

60. A method for determining positional error and remaining feature relating tolerance for a plurality of manufactured holes on an object, comprising:

determining a true position for each of said plurality of manufactured holes;

determining a framework from said true positions;

determining a location for each of said plurality of manufactured holes;

determining a size of each of said plurality of manufactured holes;

fitting said framework to said locations of each of said plurality of manufactured holes to determine a fit framework;

determining a relation for each of said plurality of manufactured holes to said fit framework;

organizing each of said relations into a single association;

organizing the location of each of said plurality of manufactured holes relative to said single association;

determining said positional error for each of said manufactured holes from said single association;

determining a common region contained within said organized

plurality of manufactured holes;

determining a maximum inscribed circle within said region;

determining the diameter of said maximum inscribed circle; and

determining said remaining feature related tolerance from said maximum inscribed circle.

61. The method of Claim 60 where said step of determining a framework from said true positions comprises

determining positional tolerances of said manufactured holes;

determining size tolerances of said manufactured holes; and

selecting an origin.

62. The method of Claim 60 where said step of fitting said framework to said locations of each of said plurality of manufactured features to determine a fit framework comprises:

determining a center for each of said manufactured holes; and

best fitting true positions of said manufactured holes to said centers of said manufactured holes.

63. The method of Claim 60 where said step of determining a relation for each of said plurality of manufactured holes to said fit framework comprises

determining a center for said plurality of manufactured holes;

determining transformed true positions for each of said manufactured holes; and

determining locations of said centers of said manufactured holes from said transformed true positions.

64. The method of Claim 60 where said step of organizing each of said relations into a single association comprises

superimposing transformed true positions.

65. The method of Claim 60 where said step of organizing the location of each of said plurality of manufactured holes relative to said single association comprises organizing the location of manufactured holes relative to a one true position.

66. The method of Claim 60 where said plurality of manufactured holes is simulated manufactured holes.

67. A method for determining positional error and remaining feature relating tolerance for a plurality of manufactured external features on an object, comprising:

determining a true position for each of said plurality of manufactured external features;

determining a framework from said true positions;

determining a location for each of said plurality of manufactured external features;

determining a size of each of said plurality of manufactured external features;

fitting said framework to said locations of each of said plurality of manufactured external features to determine a fit framework;

determining a transformed true position for each of said plurality of manufactured external features to said fit framework;

organizing each of said transformed true positions into a one true position;

organizing the location of each of said plurality of manufactured external features relative to said one true position;

determining said positional error for each of said plurality of manufactured external features from said single association;

determining a region encompassed by said organized plurality of

manufactured external features;

determining a minimum circumscribing circle about said region;

determining the diameter of said minimum circumscribing circle; and

determining said remaining feature related tolerance from said minimum circumscribing circle.

68. The method of Claim 67 where said step of fitting said framework to said locations of each of said plurality of manufactured external features to determine a fit framework comprises:

determining a center for each of a plurality of manufactured pins; and

best fitting true positions of said manufactured pins to centers of said manufactured pins.

69. The method of Claim 67 where said step of determining a transformed true position for each of said plurality of manufactured external features to said fit framework comprises

determining a center for a plurality of manufactured pins;

determining transformed true positions for each of said manufactured pins; and

determining locations of said centers of said manufactured pins from said transformed true positions.

70. The method of Claim 67 where said plurality of manufactured external features is simulated manufactured external features.